DOCUMENT RESUME

ED 380 107 IR 017 036

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TITLE Economics of Information Resource Utilization: Applied Research in the Academic Community.
INSTITUTION Memphis State Univ., TN. Univ. Libraries.
PUB DATE [95]
NOTE 40p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Costs; *Data Analysis; Higher Education; *Information Retrieval; Interlibrary Loans; Library Services; *Online Searching; Optical Data Disks; *Search Intermediaries; Trend Analysis; User Needs (Information); *Users (Information); User Satisfaction (Information); *Use Studies
IDENTIFIERS Document Delivery; Memphis State University; University of Memphis TN

ABSTRACT

This analysis of library system and service activity provides a retrospective view of user choices in a multi-system environment. Using historical data to predict future demands, conclusions are drawn from the data that should guide future planning and development activities. Ex post facto analysis of 15 years' data was performed on the use of information retrieval and document delivery, and the characteristics of the users. Results showed that mediated searching peaked through the mid 1980s, then began a sharp decline, while the average cost per search rose steadily throughout the study period. Faculty and students accounted for 80% of the total mediated search activity. Use and cost of two fee-based search services, U-SEARCH and IRS (Information Retrieval Services), are compared. The advent of the compact disc (CD-ROM) work station, with no user costs and direct user searching, altered the use patterns of the mediated search services; while the use of CD-ROM searching skyrocketed, U-SEARCH and IRS steadily declined. Surprisingly, the increase in personal searching in the CD-ROM area has not reduced service demands. Instead, reference activity shows a marked increase. Document delivery also experienced an increase in use in the same period. Document delivery data also shows an increasing gap between borrowing and lending, and the steep increase in borrowing demand since 1990 parallels the increases experienced in other service areas of the library. In general, there appears a greater willingness on the part of the user to invest time and physical effort, with the possibility of error or omission, rather than spend money for a fast, sure, guaranteed product. Thirteen figures illustrate the data trends. (Contains 26 references.) (MAS)

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ED 380 107

ECONOMICS OF INFORMATION RESOURCE UTILIZATION: APPLIED RESEARCH IN THE ACADEMIC COMMUNITY

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ABSTRACT

This research document and analysis of library system and service activity provides a retrospective view of user choices in a multi-system environment. As the library prepares for the installation of ever-more sophisticated and plentiful information delivery stations, it is incumbent to investigate and interpret user preferences and needs in the delivery of information services. Using historical data as the best projection of future demands, inquiries are represented, data tabulated and analyzed, and conclusions drawn that should guide future planning and development activities. Library and information center users are found to be driven by a variety of motivations in their researches not limited to the content of the information itself. A review of the relevant professional research communications is included as well as relevant commentary is cited referring to the value-added nature of information. A limited and highly selective bibliography is provided as are summary representations of performance measures in the past.

This research effort was supported in part by a Faculty Research Grant from the University of Memphis. The support and encouragement of Dr. Donald R. Franceschetti, Vice Provost for Research at the University of Memphis is gratefully acknowledged. Data compilations and analysis were provided by Mr. Srinivas Ghanti whose much appreciated.

IR017036

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Economics of Information Resource Utilization: Applied Research in the Academic Community

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Introduction

Academic institutions hold a pivotal role in the creation and perpetuation of the information society, and are the central institution which provides the necessary training of future scholars, researchers, and leaders of society, commerce, and the professions. With their reliance on information as the medium of scholarly and scientific exchange, their focus on problem solving activities, and coupled with their traditional existence outside the realm of quantitative, bottom line, financial considerations, academic institutions in general, and their information centers in particular, provide the opportunity for a powerful market test for the information products and services themselves. It is on these products and services that the educational enterprise relies and in which it is grounded. Colleges and universities exist in a unique niche of information production and access that can be effectively used to establish the relative "value" of information services and products and information itself. The importance of these considerations cannot be over-represented.

Value not Cost

Any discussion of the economics of information eventually devolves into a discussion of costs, benefits, values, and the like. Each of the many articles on these topics makes a contribution to the on-going discussion, though the quality of those contributions may be a some considerable variance one to another. The value ascribed to information is highly subjective, sometimes arbitrary, elusive, context dependent, use dependent, abstract, practical, utilitarian, and certainly multi-dimensional; aside from these characteristics it involves money and time, skill, training, and learning for effective recognition, selection, evaluation, and application.

The importance of the discussion, though, in general resides in the explication of the differences among cost, value and benefits. Benefits address larger, often intangible attributes of information such as personal growth, enlightenment, or edification. Cost analyses, whether input, output, or both, concern themselves with the analysis and comparison of the cost of doing something and the concomitant material return on that investment or expenditure. While these are valuable, if not essential, they are not the subject of this present work.

Value as a concept and subject of research is variously reported and interpreted and many of our ideas on this important concept range from the material and finite to the intellectual and infinite. In an attempt to reconcile the seeming irreconcilable differences in the potential interactivity of the concepts of cost and value, and fully aware that the two terms are not synonymous, this present writing seeks to examine the use of expenditure and investment data from information service operations as a surrogate for value in coordination with service choice activity and measures of use. That is to say, by observing and interpreting the information service choices made by researchers in a university community, with cost considerations and external influences kept to a minimum, we can observe the relative "valuing" activity on the part of the researcher, and derive a representative assessment of the perceived value of a) different levels of service option, and b) preferences for one service option over others. Furthermore, a model of user behavior emerges, perhaps with greater precision and higher dimensionality than previously achieved in this context. These outcomes have significant implications for the 1) designers of information services intended for end-user application, 2) information professionals whose responsibility it is to provide, instruct, and assist user in the use of these services and the referral to them, and 3) planners, managers, and administrators at multiple levels who need to understand the consequences of increased information demand and use as we advance ever further into the new world of electronic information delivery and access.

Review of Relevant Research Literature

A brief, but otherwise excellent, review of the literature to that time is provided by Griffiths (1982). She carefully divides the extant literature into its two dominant, component considerations, 1) concepts of value and approaches to value assessment and 2) the application of value assessments to information products and services. Though the former is the more prevalent in the literature, and the latter is that of the greatest concern to the practitioner and planner, each is carefully represented in this well written and balanced discussion of the better examples in each category. Griffiths, though, must conclude with the enumeration of the lingering problems of value determination, the subjective nature of the information context and other concerns which may serve to preclude or inhibit progress in (a) theoretical developments and understanding and (b) more numerous and substantive empirical study with either qualitative or quantitative importance.

Taylor (1982) provides subsequent theoretical discussion, the tone and significance of which is closely related to the work by Griffiths (1982). He examines the nature of information systems as a "series of formal processes by which the potential usefulness" of information is provided. This understanding is essential, he writes, to the view that information itself is the primary component rather than the technology that supports it, or the

content of the service or product in its material representation. That is to say that value is not inherent in the message itself, that the message has meaning, hence value, only in context, that the message is valued only by the user relevant to the immediate need or application, and that information becomes "value-added" by the enhancement or increase of these other categories, or by some method of improved notification or extended relevance. This work extends and builds upon other significant contributions by Taylor (1981, 1968, and 1985).

No adequate discussion of value as it relates to information and knowledge transfer is complete without reference to the work of Machlup (1979). The pivotal role of his work in this regard resides in the fact that many of the other writers in this topical area do so as supportive, derivative or extensive of the many works of Machlup. Among the many ideas proffered by Machlup (1979) is the notion of the multiple characteristics of value including the "exchange value" of information, as distinct from the "use value" of information. By exchange value we mean that interaction by which some sort of trade of exchange is made, usually in the monetary sense, in return for the transfer of information. This value is negotiated between or among the various principals party to the transaction. This is sometimes referred to as the "willingness to pay" concept.

Use value is identified as the extended importance of the application of the information, once again usually measured in some monetary sense, by which some external significance is attached to the information in the form of product improvement, timeliness of delivery, or other forms of real or implied efficiency of operation. The intended net effect of these activities is some improved return on the information investment. Capitalist society has found it convenient to measure these exchanges in monetary or fiscal terms. This is, of course, most notable in the commercial sectors, recent representations of which are found in Estabrook (1986), Matarazzo & Prusak (1990), Eddison (1990), and Prusak & Matarazzo (1990). Applications in the not-for-profit sector have also been noted including Ensor & Hardin (1991) and the especially well written analysis provided by Slamecka et al. (1986). Similar to the extensive cost analysis used by Slamecka the work of Virgo (1987) is noteworthy for its deft handling of the varieties of "cost." Though cost <u>per se</u> is not the consideration here, only by a thorough understanding of the cost perspectives do we have much chance of fully understanding the concept of value in the practical and applied cases with which many of us are confronted daily.

Returning to the theoretical perspectives on which we so heavily depend for our understanding, Repo (1989) has revitalized this approach by a thorough examination of the theoretical interpretations of the value of information by examining the contributions of economists, accountants, and management. It is noteworthy that this analysis concludes that approaches to valuation from the standpoint of information theory alone have largely failed to achieve significance in their practical applications, but that there is still importance to be found in the

application of traditional economic approaches which rely heavily on exchange values. Further, there is promise of success when use value is coupled with extended analyses of tasks performed with special reference to cognitive activities and their analysis.

Perhaps of greatest single contributor is King whose many works have appeared either singly (1977) or with others King, McDonald & Roderer (1981), King, Griffiths, Roderer & Wiedekehr (1982), and King and Griffiths (1985). Each of these contains significant contributions to our theoretical understanding supported by solid empirical research, investigation, and interpretation. Of particular importance to this research is the work of Caroll and King (1985). They offer that the value of information should be approached from one or more of the following perspectives: the reader, the organization, or society. Particularly noteworthy in this context is the explication of the "effective" price the users pay for information, which is more than merely monetary, including as it does, time and effort expended, the time or monetary savings earned by information use, and the extension of personal value represented by the "willingness to pay."

A final noteworthy contribution to this essential discussion of the value of information to the individual is found in the work of Rouse (1986). He makes important distinctions in the matter of information needs and activities of individuals engaged in the problem solving and information gathering activities associated with CAD/E efforts. Rouse notes that the three most important attributes of information in the applied activities with which he is concerned are 1)reduction of uncertainty, which we may consider to be similar to authority, accuracy, and clarity; 2) task relevance with appropriate references to the difficulty of determining relevance beyond the subjectivity of the user; and 3) appropriateness of form, identifying the problem of language as one to which we may add inaccessible format, absence of correct equipment for translation or use, and other calamities of modern times. Though not part of this study, Rouse's comments on aspects of relevance bear our notice and attention. Furthermore, Rouse is to be commended for his explication of the circumstances of the researcher for whom the problem to be solved is generally represented publicly in its aggregate form. For successful resolution of the problem, the topic must be decomposed into its constituent and manageable parts. Because one problem exists in the aggregation of many constituents, and the solution of the constituents is essential to the solution of the entire problem, and because the problem's part's solutions are not necessarily linear in their handling, Rouse observes that the researcher proceeds heterarchically, in a manner that to some would suggest disorder, randomness, or chaos. What is significant here is the realization that major research problems are not solved by one fell swoop. They are dis-aggregated, taken apart and dealt within manageable parts, piece-meal fashion, until they are reassembled in the main form. This interpretation of the research and problem solving endeavor has significance to the activity of university

researchers as well, and perhaps provides insight in to the use of institution and information center resources. It is useful to note that Rouse bases much of his writing on the extensive researches of cognitive sciences not the least of which is his own significant body of research work detailed in his bibliography.

Description of the Study

This present research investigates the relationship of several factors that will stand for elements of cost and thereby serve as surrogates for the measure of value associated with the information activities they measure. It is useful to bear in mind the characteristics of the university environment. The purposes of the institution are frequently summarized as the obligation to provide teaching, service and research and so doing strive to create, verify, validate, disseminate, and systematize knowledge for the benefit of society at large in addition to the research community of which it is a part. To say that universities are in the knowledge business is a virtual understatement. Furthermore, the teaching obligation of the university is such that its skills and resources are brought to bear for the purpose of training future researchers in the research skills and pedagogical inquiry techniques that will develop their own scholarly and intellectual powers. It is within this framework that this current research examines the relationship between information needs and their concomitant costs in an attempt to identify the dimensions of value associated with information products and services and ultimately with "information" itself.

Within these variant operational, theoretical, and material contexts, this research addresses several questions:

1) Is information service activity responsive to demand placed on and by external influences?

2) Is demand responsive to cost?

3) Is demand responsive to training time/skill development needs?

4) What factors determine the selection and use of information services?

5) What deterrents exist which impede the effective use of information services?

6) What factors influence the limits of acceptable performance for the selection and use of information services?

Observational Environment and Data Gathering

Observations were made of the use made of alternative sources of information and among competing information services in a

university information environment. Conducted as an ex post facto analysis of use data, these observations are independent of perceived intrusion and observation.

Historical data from the operation of Memphis State University Libraries were used to describe as many as fifteen years of information services in an academic library reference department. These services are provided free of charge to the university user-community and their access is limited only by scheduling and the level of demand. Typically mediated, human-intervention services are available as many as 89.5 hours per week with multiple staffing options available. Every reasonable effort is made to provide timely and adequate level of assistance. Some of the available information resources involve the use of external information resources which must be compensated, i. e., royalties for computer user, copyright costs, telecommunications, and photocopy fees among others. While these are standard components of the operational costs of libraries and information centers of all kinds, and in view of the fact that the bulk of these costs are, on an incremental basis, minimal, it is surprising to find the significant sensitivity to cost imposition and, hence, some degree of value is established for these information services.

Characteristics of Information Resources Under Inquiry

Two typical services, information retrieval and document delivery, were selected for purposes of this study and their use data were analyzed while the use characteristics of the users were studied. Each requires some relevant description.

What we may now call "traditional information retrieval services" (Information Retrieval Services, "IRS") were initiated at MSU in 1970, becoming fully online in 1976. Explosive growth was accomplished in the early to mid 1980"s as the popularity of mediated searching grew and the demands of research and publication increased. An End-User service was initiated in the mid-1980's for those individuals who wanted to do their own searching becoming the first instance of dis-intermediation. This service used the same computer systems as the mediated searching, most of the databases were available, but the researcher was forced to conform to the institutional schedule, learn the system provided by the vendor (BRS and DIALOG), and they were willing to pay for the privilege.

Compact disk databases became operationally available in early 1988 and the process of disintermediation was complete with the end user doing their own work, without training, or cost but confined to a schedule that sought to assure equitable allocation of a scarce (and highly popular) resource to the maximum number of researchers. Given that these services were largely comparable in the database categories, the selection of one service over another is representative of the value based choices made by the individual.

The second case for meaningful observation involves the Interlibrary Loan/Document Delivery Service (ILL/DDS) used in this university information community. Historical figures are available

which indicate the growing importance of this vital service to the user community. Various technological innovations have entered into this area of activity, just as in other information centers. The net effect of these is the facilitation of the work and effort of those who actually do the work; they have some slight chance of keeping pace with demand. In addition to the technological improvements, external services were occasionally used to provide data resources, though the availability of these options was largely ignored or avoided by the user community. The cost options were deterrents to use.

Results

Mediated searching through the MSU Libraries peaked through the mid-1980's attaining a virtual plateau of demand at approximately 1,300 paid searches each year. (Figure 1) The average cost per search rose steadily during the same period reflecting general inflationary pressures and actually declined around 1988. A steep increase was experienced in 1989 due in large part to the shift of low-cost searching of ERIC and MEDLINE searches to other services. These data are shown in Figure 2. The average cost of a retrieved citation also rose during this time period, though at more erratic pace as shown in Figure 3. By the end of the decade the average cost of each citation was nearing $0.55. Once again the shifting of search activity in low cost database to other services is largely responsible for the problems of aggregation. Figure 1 revealed a slight dip in 1984-86 time period. A partial explanation may be found in the implementation of the end-user service (known as U-SEARCH) at that time as revealed in Figure 4. This service competition, though well received at the time is not wholly responsible for the decline, there being other reasons, such as general economic conditions and variations in user population accounting for an undetermined portion of the change.

Faculty and students (mostly graduate students) accounted for 80% of the total mediated search activity with faculty leading that group by a ratio of approximately 3 to 2. Figure 5 shows the variations over time. The momentary peaks and valleys are largely off-setting suggesting merely inter-category shifts and not actual population declines. A different pattern of service selection is found in the case of U-SEARCH where faculty rarely accounted for more than 10% of the activity and graduate students and undergraduates dominated the user population. It is interesting to note that while available to anyone, few undergraduates ever used the mediated service. When U-SEARCH became available, within two years they had become the largest category of user. Their perception of the relative inexpense of the service accounted for much of its popularity. This change is demonstrated in Figure 6. The reality of the cost differentials between U-SEARCH and the IRS searches is clearly shown in the comparison of average search costs found in Figure 7. With costs of double or more, the impression among the undergraduates was that the service was beyond their

financial reach. The steep rise in both categories in 1988-1989 was due, again, to the shifting of the cheap ERIC and MEDLINE searches to other services.

As has been rightly anticipated the significant change that altered the use patterns of these two information services was the advent of the compact disc work station. The explosive impact on institutional services is clearly shown by Figure 8. What is even more startling is the realization that the scale for the CD-ROM activity is not the same. For numerical accuracy the viewer must multiply by a factor of 1,000. To clarify, the number of CD-ROM searches by 1992 was in excess of 24,000 per year. It should also be plain to the reader that the introduction of personal searching in this category dramatically affected the other services. IRS searching is now less than one-fourth its highest levels and U-SEARCH has largely ceased to exist. U-SEARCH though does have an off-spring in the form of LEXIS/NEXIS searching which is enjoying increasing popularity; its availability is limited to university faculty and students, but is wholly subsidized by the university.

Perhaps one of the more surprising results of all of this activity is more activity in other areas. Not fully anticipated in general reference services, the increase in personal searching in the CD-ROM area has not reduced service demands; rather, general reference service has experienced a marked increase, as shown in Figure 9, that closely parallels the time of greatest growth in cd searching having remained largely stable for the previous three years. A new plateau of service level appears to have been reached. This may also indicate that service provision may have reached a plateau representing a level of saturation that cannot be addressed without additional staffing or longer operational hours which would also require more staff. Lest criticism suggest that the increase in general reference services is attributable to assistance provided to CD-ROM searching assistance, Figure 10 depicts the comparative measure of reference question answering which is quite separate from computer assistance. To be sure, the increase in service activity is at least indirectly attributable to the CD-ROM capability as more users, with more questions, are making use of the library services. Though not shown here, library use, materials circulation, and journal use, have also shown similar increases.

Document Delivery, previously known only as Interlibrary Loan, has experienced increased use in the same period. The general patterns of service growth in all areas are largely similar with only the service options changing. Unfortunately, MSU Libraries has been a net-borrower of library materials since 1985 and the gap between our borrowing and lending is increasing. In addition to that circumstance, Figure 11 also shows the steep increase in borrowing demand since 1990 paralleling, with a two year delay, the heavy increases experienced in other reported service areas of the library. Not shown in a graphic relation the cost of the average interlibrary loan to the library user increased nominally during the last decade. These costs have been kept low due to the excellent level of regional cooperation enjoyed by the MSU

Libraries and the effective use of reciprocal resource sharing agreements.

In the matter of Document Delivery Services/Interlibrary Loan (DDS/ILL) a striking characteristic is seen. Here more than in any other service, the rejection of delivery or information supply is most notable. Users, whether faculty or graduate students, will cancel requests when the probability is high that charges will be incurred above financial thresholds. Though it is impossible to identify the precise monetary cost level that is over the limit, for students it appears to be approximately $2.00 on average. Faculty, when personally paying for the service have an implied limit approximating $4.00. Both of these cost levels are well below the minimum $6.00 cost for commercial document delivery options which have been available for nearly 10 years but scarcely used.

When academic departments are paying for faculty borrowing, (and the same is true for mediated searching) much higher cost limits are in place reflecting the individuals willingness to spend other people's money more freely than his or her own. In these instances, the users willingness to forego documents, that is, information, is clearly prompted by expense. Opportunities for substitution, and the absence of a sense of a penalty for omission, contribute to the implied valuation of the information content of the identified document as well below the average cost of slightly more than $2.00 for each supplied document. Further, when given the option, the user, faculty or student alike, will wait up to 10-14 days to receive a copy for free, rather than pay nominally for more timely delivery (usually within 2-3 days). On demand document or information supply at premium prices ($7.00 or more) is almost universally eschewed.

Characteristics of Information Resource Users

A user model descriptive of information resource selection and use emerges that is multi-dimensional and stratified by user category, that is, differentiated by faculty or student status. This stratification is not absolute and is marked by matters of degree rather than absolutes; that is, financial thresholds and options for subsidy, substitution, time delay, personal effort, and few perceived penalties for sub-optimal behaviors are the defining factors.

User Model or Paradigm

Generalizations are extraordinarily dangerous in all instances, but seem even more so in the case of library services where needs are variable, options are multiple and the strength of external forces and rewards is minimized. Still, we are confident enough of these observations to cast certain observations about information service users operating in a situation of competing choices. Students, for example, when confronted by time demands will defer to short time-on-task solution. In just over half of

the observed cases, students would substitute, omit, or alter information request in favor of time expedient. Students will defer consideration of adequacy over the time requirement or cost increment.

Without doubt some faculty will refuse to pay for any delivered document "on principle" asserting that it is the department's responsibility to support their research activities; if the department refuses, or is unable to pay or cannot budget further funds, the faculty will "retaliate" or reciprocate and likewise refuse the document. The consequences to scholarship may be more implied than real in that there are other options which permit continuance of the project. Faculty members are less likely to defer to time or cost over information need-satisfaction. Though cost is a concern, as illustrated in the foregoing dimensions, it is less a concern than providing the adequacy of the solution to the research need. Faculty members are more likely to pay personally for needed information contained in externally provided documents, and are more likely to wait for their arrival than students who will exercise circumlocuitous options of information use in the immediate or short-term experience. Faculty are more likely to persist in the solution of their research needs based in the literature than students. Students are more likely to deviate from, or reformulate, the original problem into a manageable information format that is soluble in short order with minimum expenditure and effort.

Given the vagaries of the circumstances in general and the variety of options and deterrents at work in any and all of these circumstances, it is perhaps useful to illustrate these observations in the following Value Matrix. Keyed to the operations of document delivery, it compares the relationship of three approaches to information supply, personal effort, traditional interlibrary loan, and document delivery through commercial suppliers. The matrix illustrates both positive and negative attributes and indicates the degree of involvement High (H), Medium (M), or Low (L); the meanings of these reverse when moving from negative to positive attributes of the experience on the part of the user. A second matrix illustrates the relationship among the same "cost" variables for the three variations of electronic information retrieval service offered and discussed previously.

VALUE MATRIX
INFORMATION ACCESS AND DOCUMENT DELIVERY

POSITIVE ATTRIBUTES	Personal Search	Inter library loan	Document Delivery
Training Time/ Experiential	H	M	L
Time on task requirement	H	L	L
Time to completion	H	M	L
Convenience of use	H	H	L
Currency of information	M	L	L
Scope	H	L	L
Quality of information	M	M	M
Authority	M	H	H
Substitutability	H	L	L
Administrative Restrictions	M	H	L
NEGATIVE ATTRIBUTES	********	*******	********
Cognitive skill requirement	H	L	L
Penalty for omission	M	L	L
Physical effort required	H	M	L
Certainty of delivery/success	L	M	H
Anonymity of project/activity	H	M	H
Proximity of activity	H	M	L
Competition for resources	H	H	L
Cost, monetary or equivalent	L	M	H

VALUE MATRIX
INFORMATION RETRIEVAL ACCESS MECHANISMS

POSITIVE ATTRIBUTES	MEDIATED SEARCHES	U-SEARCH	CD-ROM SEARCHES
Training Time/ Experiential	L	H	M
Time on task requirement	L	H	H
Time to completion	L	M	H
Convenience of use	M	L	H
Currency of information	H	H	M
Scope	H	M	L
Quality of information	H	M	L
Authority	H	H	M
Substitutability	L	M	H
Administrative Restrictions	M	H	M
NEGATIVE ATTRIBUTES	********	********	********
Cognitive skill requirement	L	H	M
Penalty for omission	M	H	H
Physical effort required	L	H	H
Certainty of delivery/success	H	M	L
Anonymity of project/activity	M	H	H
Proximity of activity	L	M	M
Competition for resources	M	H	M
Cost, monetary or equivalent	H	M	L

In the case of this matrix, which compares comparable services that vary principally in the relation of cost and effort, that is the target data sets are roughly equivalent, it is noteworthy to recall that it is the last column that reflects the most popular and heavily used of the services by a factor of at least 60.

Implications for Information Services and Products

The findings of this analysis suggest several implications for information service providers, managers, planners and funding agencies, in this case the college or university. With the effects of monetary exchange minimized by choices available, other factors may come to influence the selection of competing resources. However, it is also noteworthy that as the use of comparatively sophisticated end-user information technologies becomes available, the use patterns of other resources is also found to increase. Given that these sources are largely mutually exclusive in application and activity, the strong implication is that as one service area increases in its availability and popularity, other services experience growth in demand and activity as well.

In view of the emerging user model or paradigm for selection and use of information resources, it is interesting to note that there appears a greater willingness on the part of the user to invest time versus money for the same end product. Along with that time spent, there is an apparent price-inelasticity. The user would rather not invest actual dollars in an exchange mechanism for information if an alternative exists; hence, the general drop in mediated searching approaching a new plateau of activity not unlike that achieved in its ascendancy. There is a proportion of the population that is more likely to pay for the service, reasonably priced, and free of other "costs" in the form of other attributes as depicted in the Value Matrix presented supra.

For others, though, the investment in personal time is seen as preferable to the dollar expense. Along with that investment in time are the concomitant factors of travel, schedules, learning, and waiting. The combination of all of these factors is still found to be less than the investment of actual money for the benefits of the mediated search. Surely other factors are involved though they may be even more elusive and indeterminant. Further, given the extended access available to home users of these services, the larger proportion of the user population prefers, perhaps for financial reasons, to travel to the library and work within schedules and administrative restrictions, rather than pursue this work through the provision of their own personal equipment for computer and telecommunications access, software purchase, installation, and learning, and the necessary expenses involved with all of that. One thought is that these information seeking activities are viewed in the main as transitory activities that are associated only with the process of formal education, the need for which will evaporate immediately upon graduation or other termination.

Conclusion

Technological innovation has rewritten the information access equation. The valuation equation now tends toward ease and convenience of use in the absence of dollar cost or financial

investment in equipment and the increased willingness to submit to organizational, institutional, or bureaucratic limitations and to invest time and physical effort in the satisfaction of an information seeking problem, with the possibility or error and omission, rather than expend funds for a fast, sure, guaranteed product.

The unprecedented growth of INTERNET access and use should not be attributed exclusively, or even mainly, to a romance with the keyboard and monitor/vdt/crt. Issues of cost, convenience, privacy, and efficiency are found to be extremely influential in these decision activities. Skill levels are subordinated to a reliance on trial-and-error behavior. Rather than quickly and efficiently enter, point, retrieve, and transfer, the more typical user, if this research has any predictive qualities or merit at all, will meander and gather indiscriminantly, moving whichever way the gopher points. The implications for channel capacity, delays, and system features to facilitate searching are significant as we move inexorably down the on-ramp of the information superhighway.

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SEARCH ACTIVITY BY YEAR (IRS)

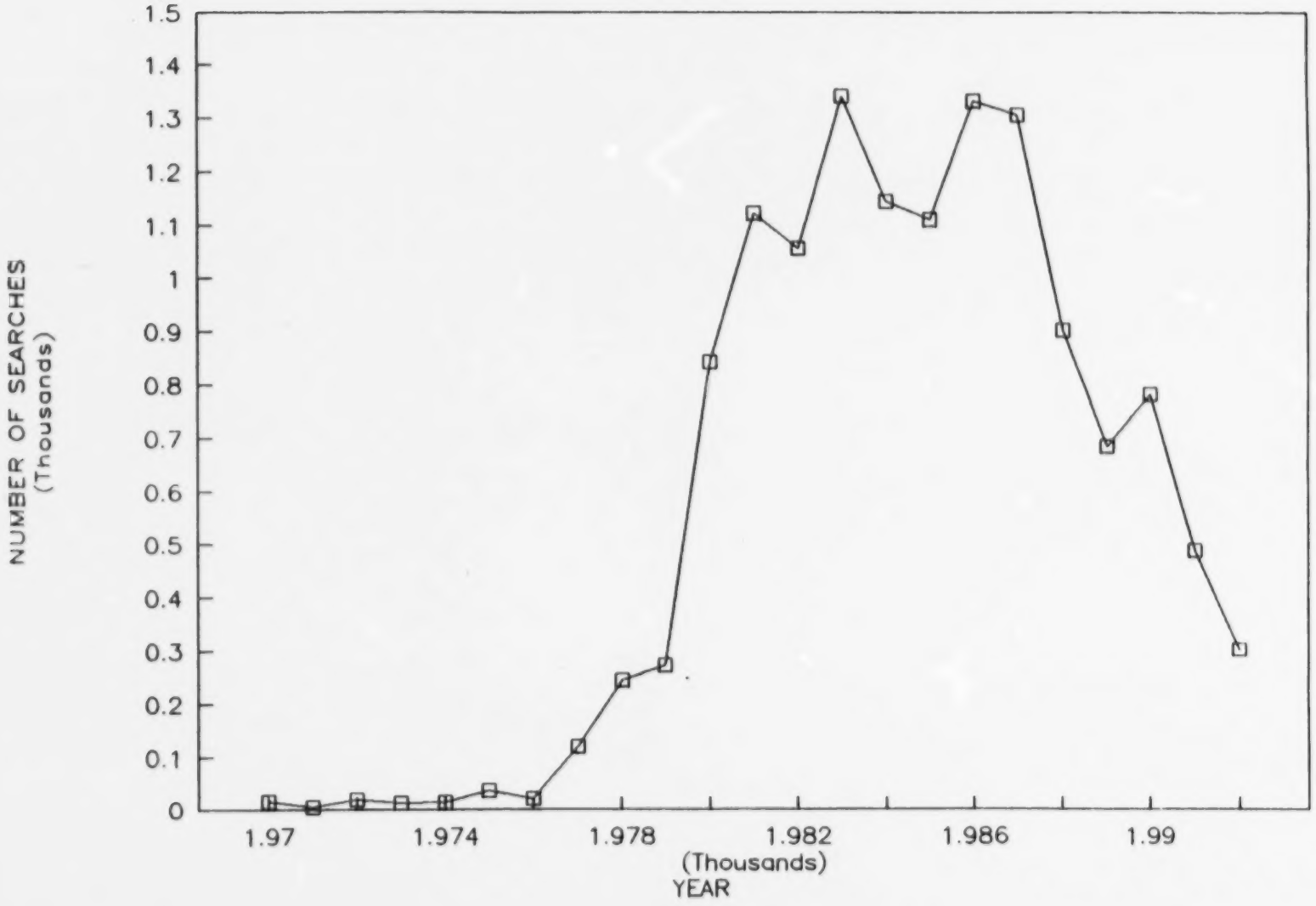

FIGURE 1

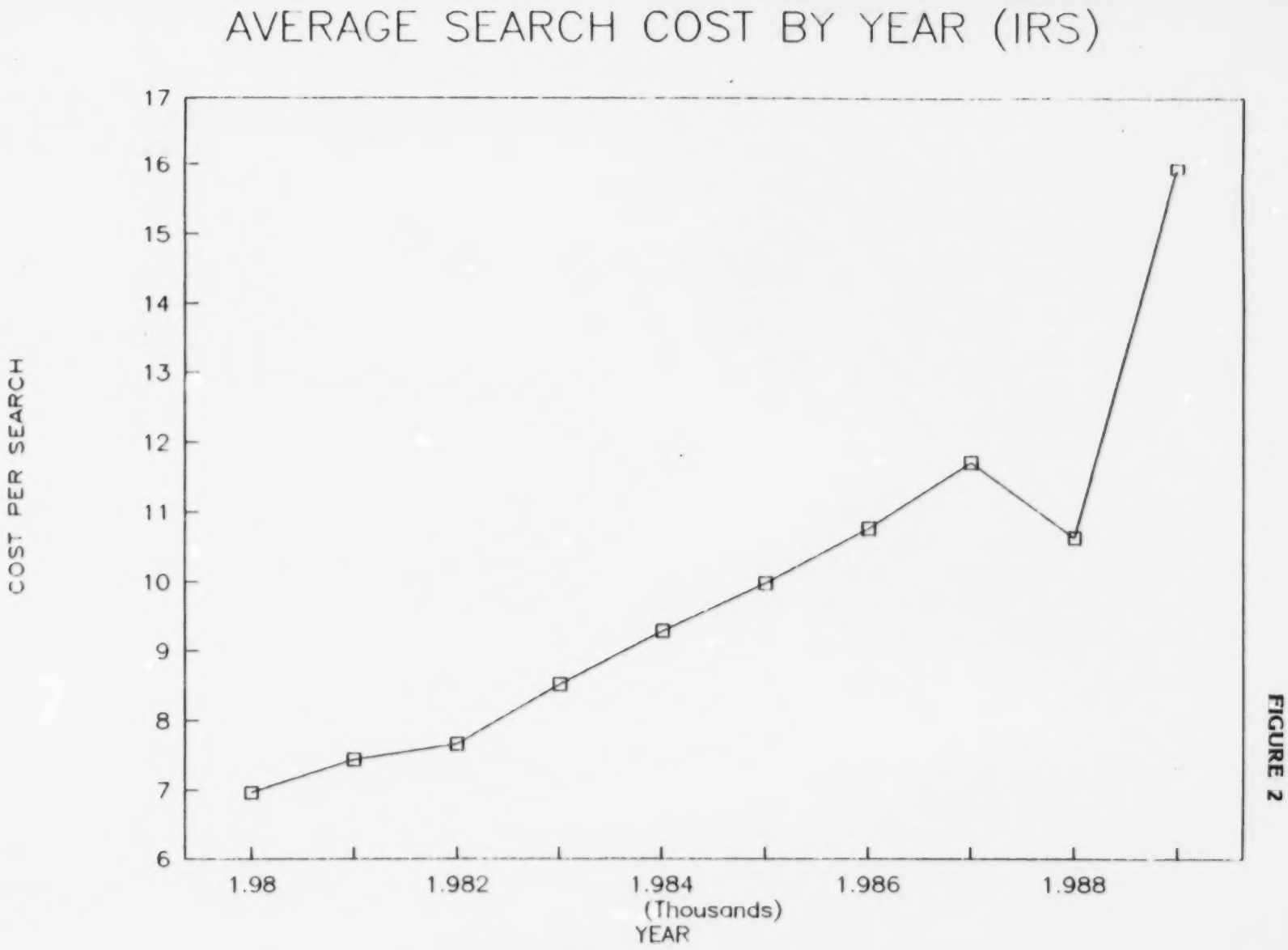
AVERAGE SEARCH COST BY YEAR (IRS)
COST PER SEARCH
17
16
15
14
13
12
11
10
9
8
7
6
1.98
1.982
1.984
1.986
1.988
(Thousands)
YEAR

FIGURE 2

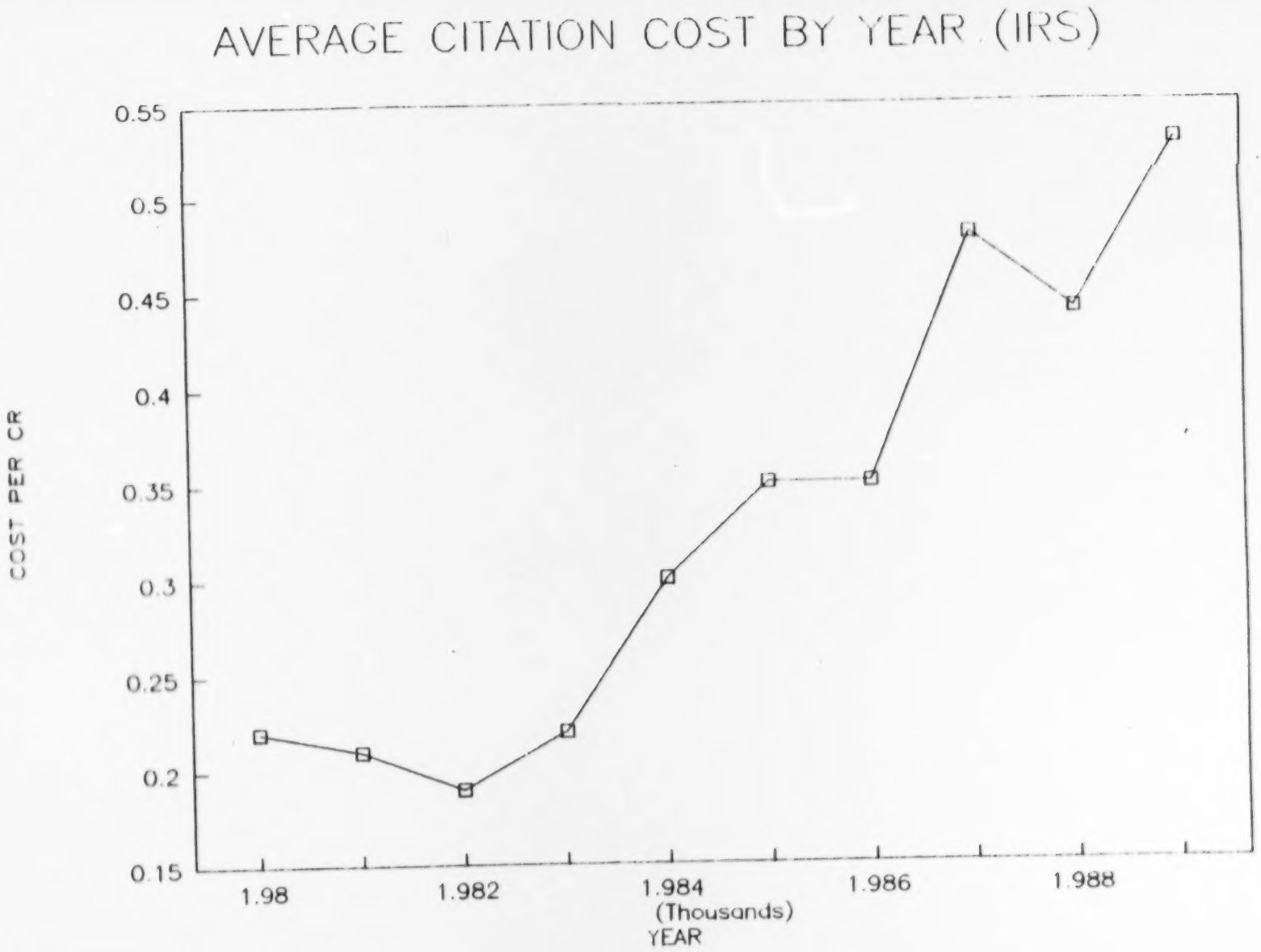
AVERAGE CITATION COST BY YEAR (IRS)
COST PER CR
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
1.98
1.982
1.984
1.986
1.988
(Thousands)
YEAR

FIGURE 3

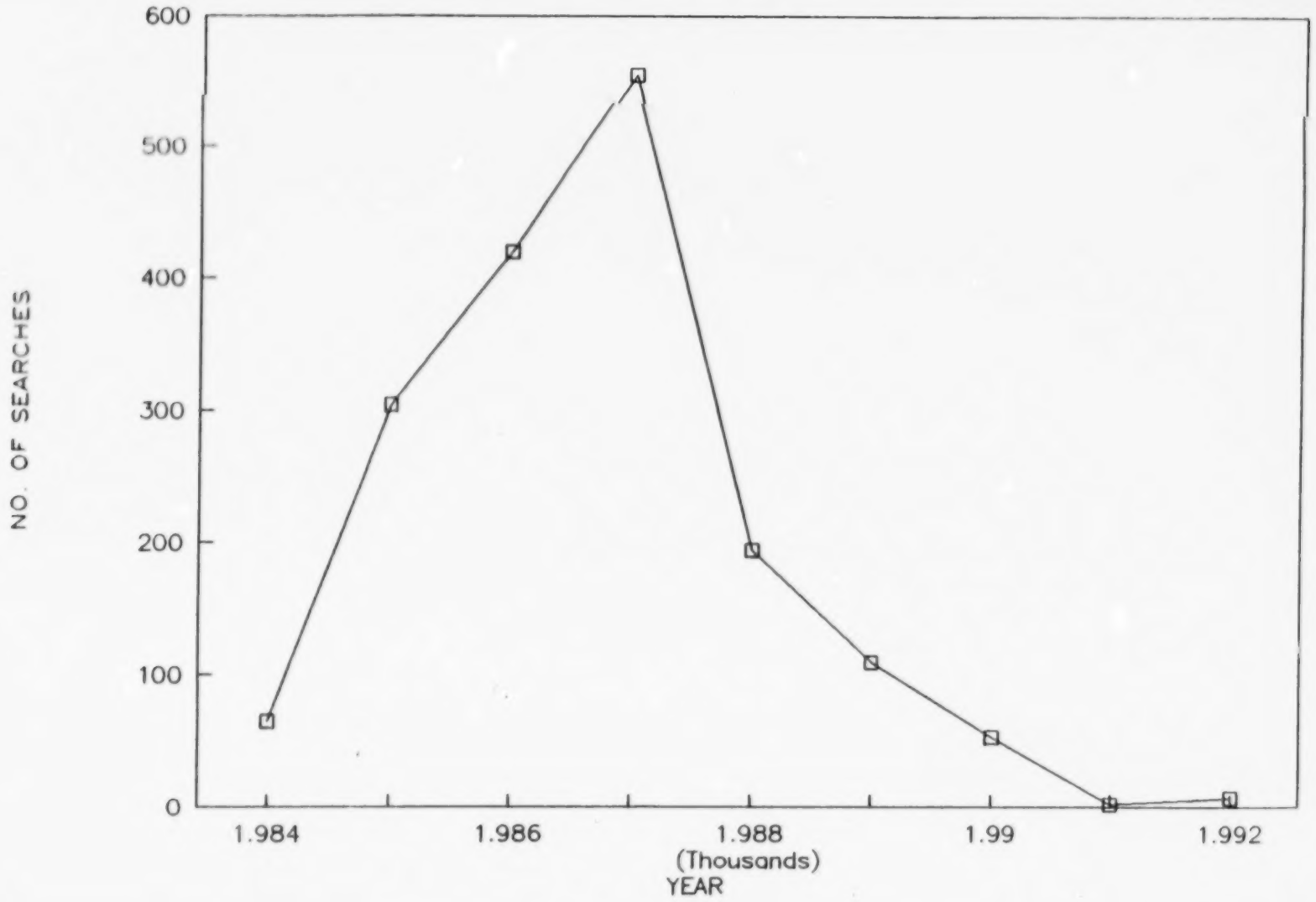
U-SEARCH ACTIVITY BY YEAR
NO. OF SEARCHES
600
500
400
300
200
100
0
1.984
1.986
1.988
1.99
1.992
(Thousands)
YEAR

FIGURE 4

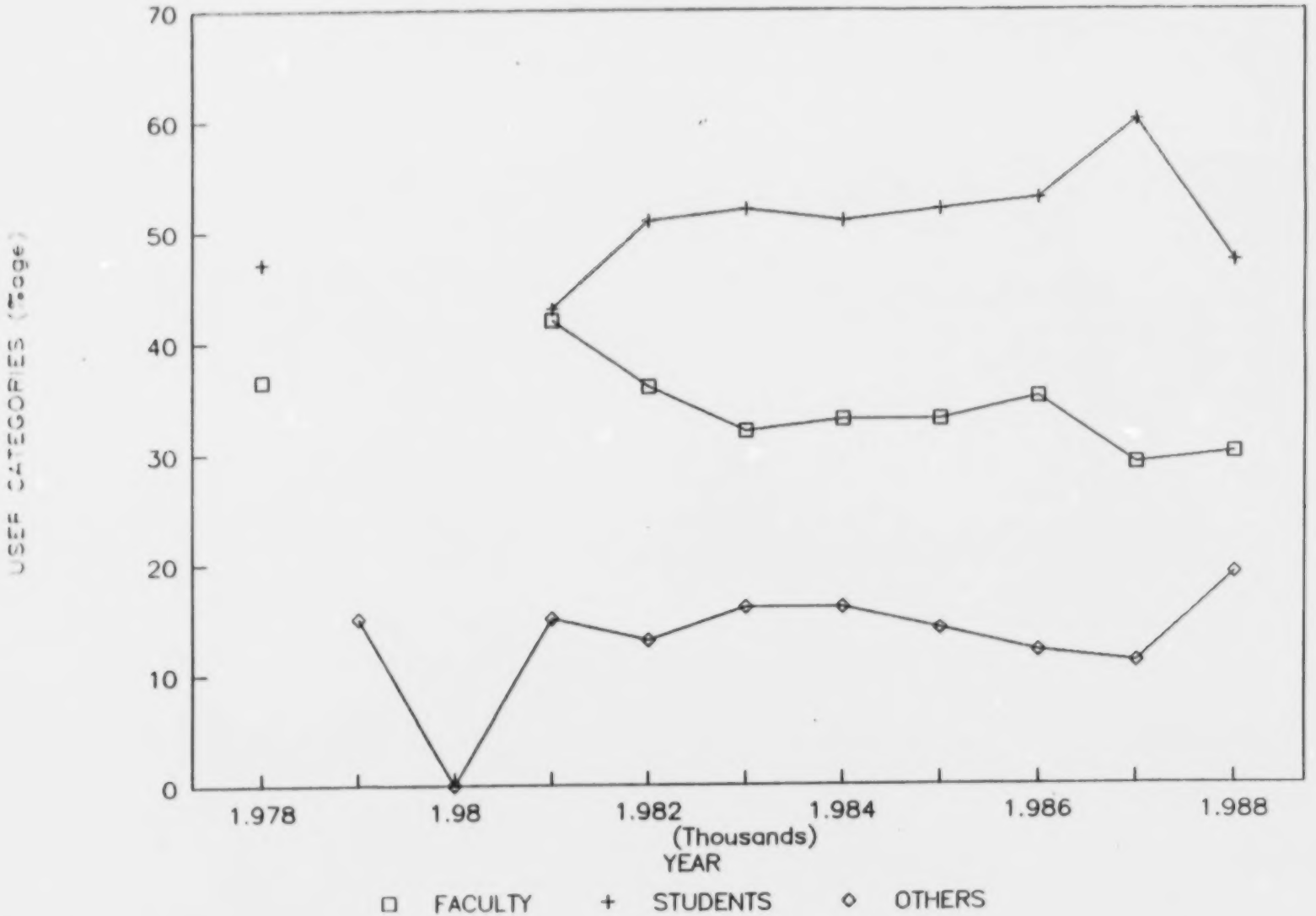
IRS SEARCHES
USER CATEGORIES (Page)
70
60
50
40
30
20
10
0
1.978
1.98
1.982
1.984
1.986
1.988
(Thousands)
YEAR
FACULTY
STUDENTS
OTHERS

FIGURE 5

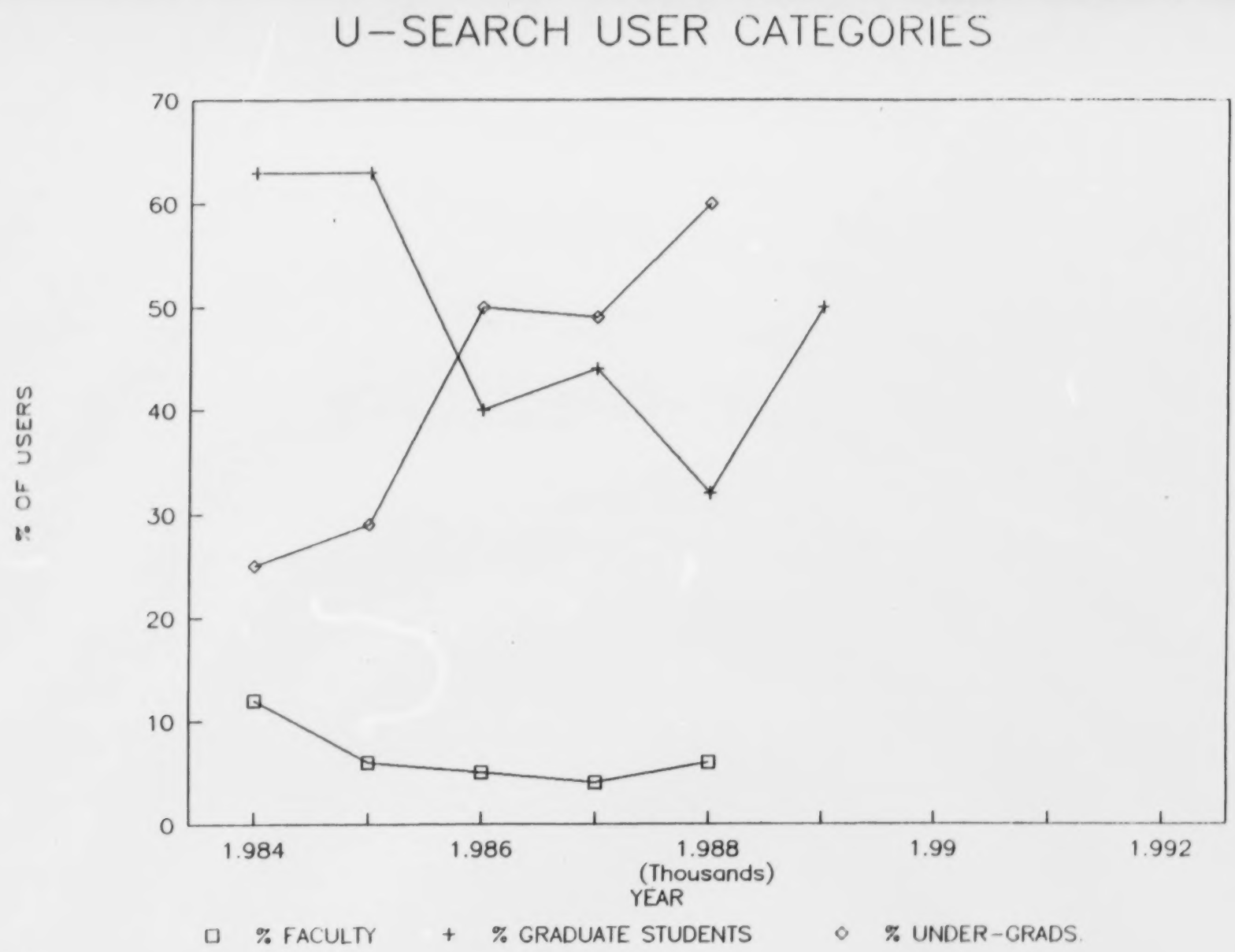
U-SEARCH USER CATEGORIES
70
60
50
40
30
20
10
0
% OF USERS
1.984
1.986
1.988
1.99
1.992
(Thousands)
YEAR
% FACULTY
% GRADUATE STUDENTS
% UNDER-GRADS.

FIGURE 6

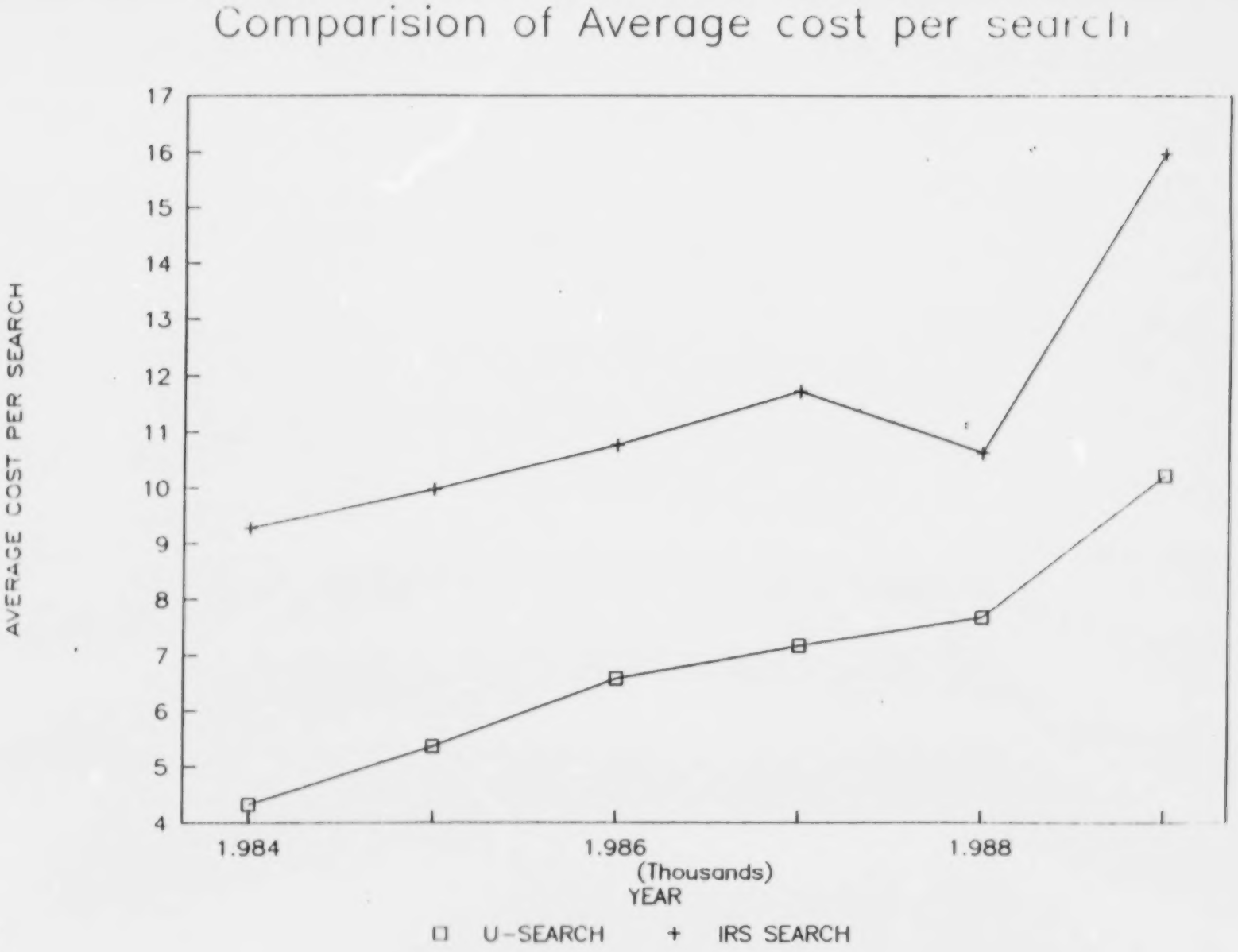
Comparision of Average cost per search
AVERAGE COST PER SEARCH
17
16
15
14
13
12
11
10
9
8
7
6
5
4
1.984
1.986
1.988
(Thousands)
YEAR
U-SEARCH
IRS SEARCH

FIGURE 7

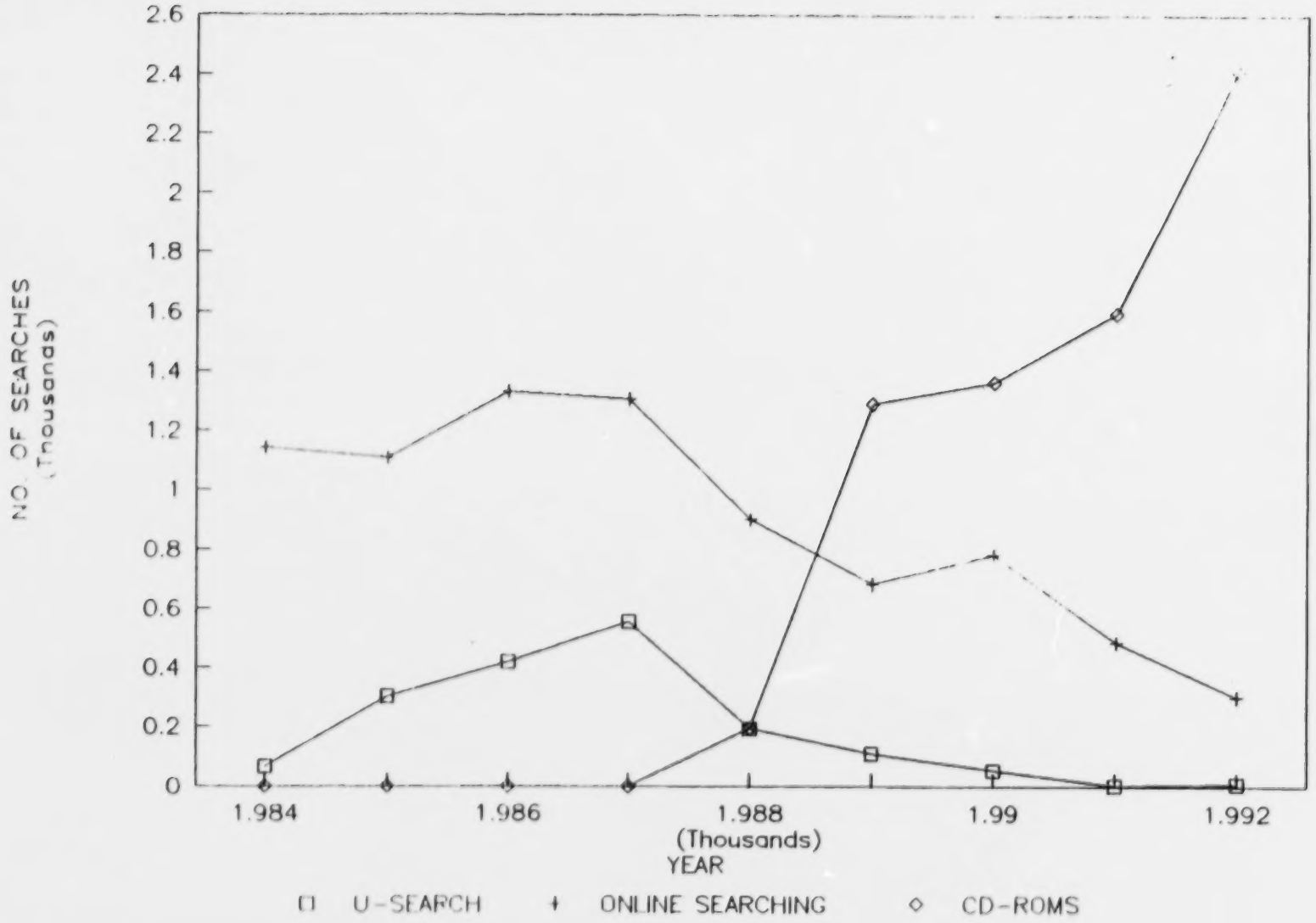
NO. OF SEARCHES
(Thousands)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1.984
1.986
1.988
1.99
1.992
(Thousands)
YEAR
U-SEARCH
ONLINE SEARCHING
CD-ROMS

FIGURE 8

PERSONS SERVICED BY YEAR

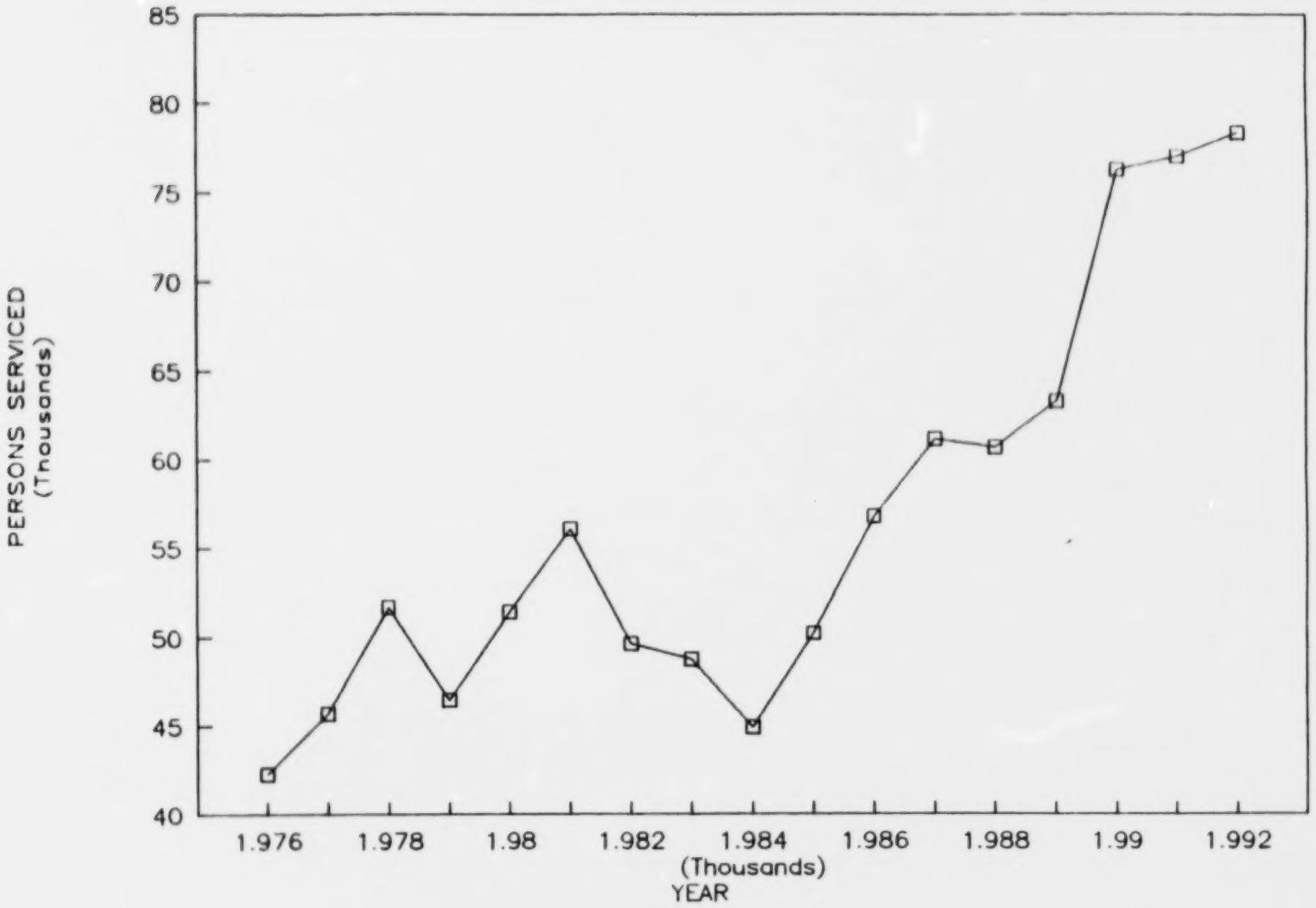

FIGURE 9

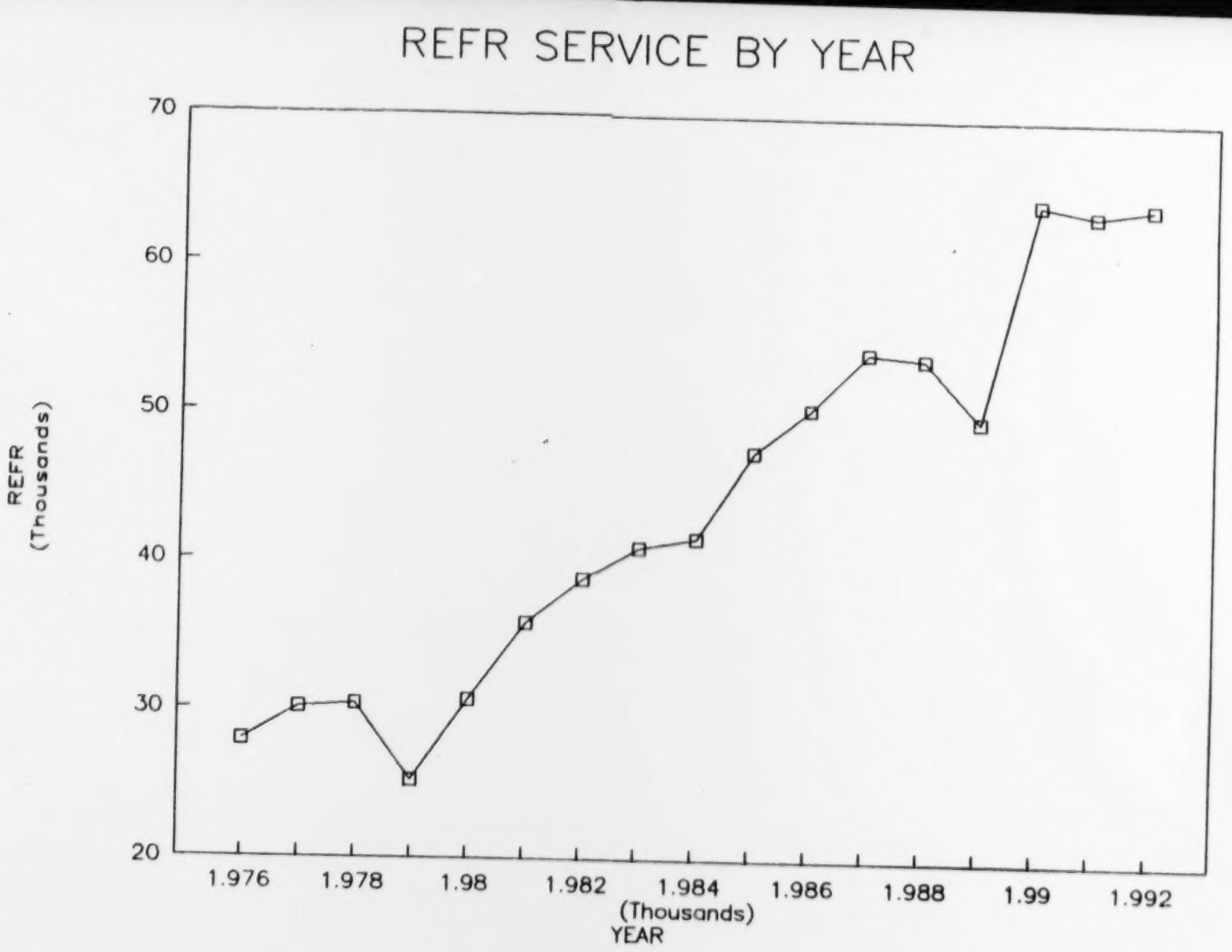
REFR SERVICE BY YEAR
70
60
50
40
30
20
REFR
(Thousands)
1.976
1.978
1.98
1.982
1.984
1.986
1.988
1.99
1.992
(Thousands)
YEAR

FIGURE 10

DOCUMENT DELIVERY SERVICE STATISTICS

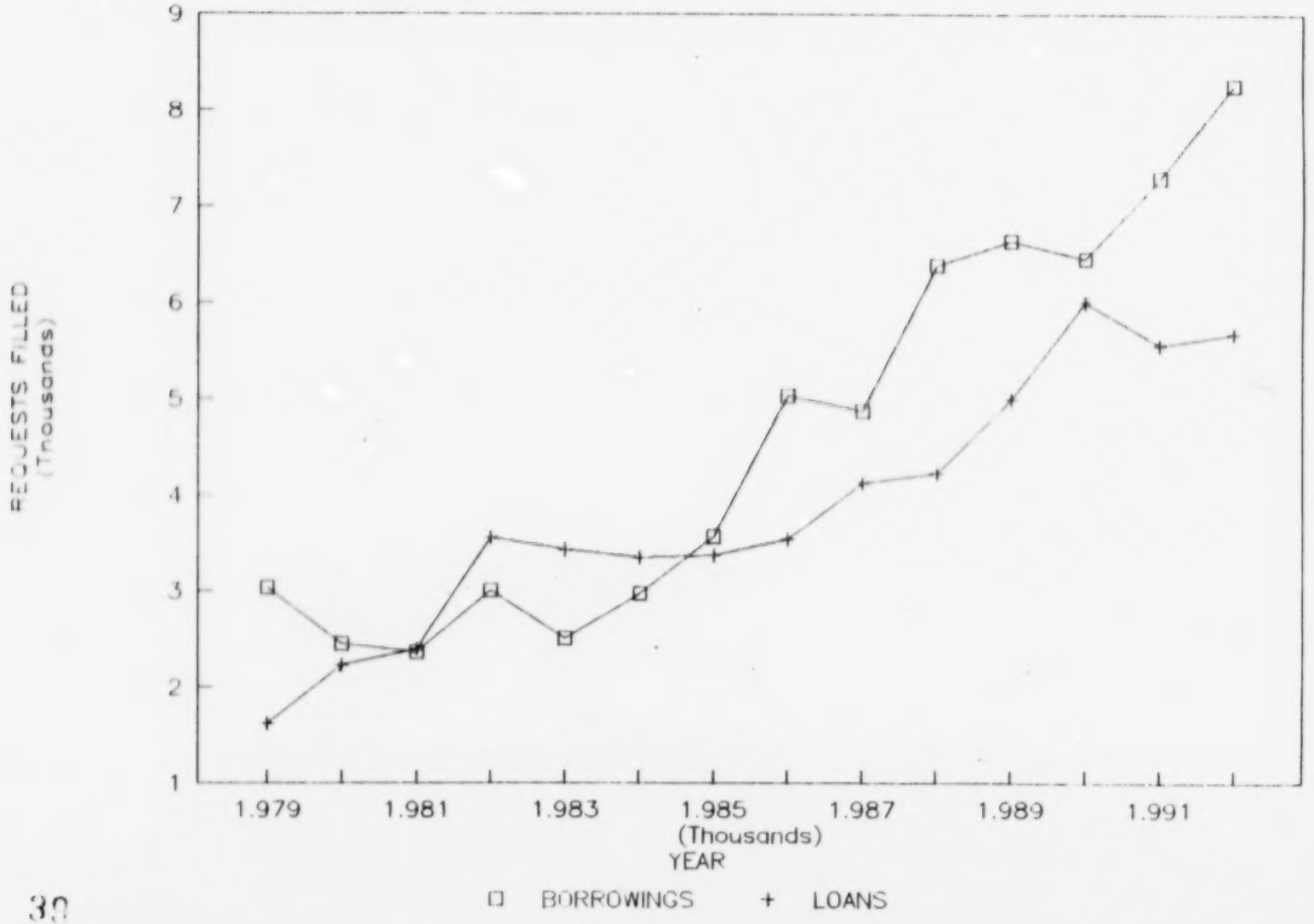

FIGURE 11

BEST COPY AVAILABLE